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ORIGINAL ARTICLE

Clinical characterization of mouth opening among Mexican adolescents and young adults

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Abstract *Objective:* To estimate two mouth opening (MO) assessments in a sample of apparently healthy Mexican adolescents and young adults, in the context of age and sex.
Material and Methods: We examined in a cross-sectional study 254 subjects 14 to 24 years old to ascertain the maximum MO (MMO) and the assisted maximum MO (AMMO) using a ruler (Scala®). The measured mouth opening capacities were not adjusted by adding the vertical overlap between arches (overbite). Clinical oral examinations were undertaken by four standardized examiners. Statistical analyses included Student's *t*-test and linear regression modeling.
Results: Mean age was 16.76 $\pm$ 2.39 years and 53% of the 254 participants were men. Overall mean MMO was 46.61 $\pm$ 7.37 mm (minimum 28, maximum 69), and AMMO was 49.48 $\pm$ 6.59 mm (minimum 32, maximum 75). Age had no identifiable relationship with MMO or AMMO but we observed that the mean difference between men and women in MMO and AMMO was 3.29 mm ($P < 0.001$) and 3.16 mm ($P < 0.001$), respectively.
Conclusions: Besides finding that Mexican young males have higher mean maximum mouth opening than females, the present study offers some of the first anthropometric outline relevant to orthodontic, prosthetic/prosthodontic developmental calculations for an important parameter of normal mandible/maxilla function among Hispanics/Mexicans.

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Introduction

Mandibular function is assessed through a series of diagnostic procedures, including palpation of the masticatory muscles and temporomandibular joint (TMJ), an occlusal evaluation, and radiographic/cephalometric examination; these are often supplemented by tests of lateral and protrusion movements and evaluation of mouth opening (MO).[1] Limitations or pain during mandibular movements (and more directly, while opening)[2] may be related to different conditions such as TMJ disorders, odontogenic infections, oral submucous fibrosis, trismus, development and congenital anomalies, and facial trauma.[1–7] Limitations of MO have implications for both patients and dentists. Another consideration that is nevertheless important is when anesthesiology maneuvers need to be undertaken, i.e., a limited MO has negative consequences when performing procedures like endotracheal intubation.[8,9]

MO seems to be related to factors such as age and sex, and to anthropometric features such as height, race, mandibular size, and cranial base size. Interestingly, few studies have been performed around the world to determine what a normal opening range is in "healthy" individuals. Mexico and the Mexican population lack a reference framework to determine this clinical parameter. The objective of the present study was to estimate two measures of maximal MO (MMO) in a sample of Mexican adolescents and young adults and to determine their relationships with age and sex.

Materials and methods

Design, population, and sampling

This study complied with ethical and research regulations of the Dental School at the Universidad Autónoma de Campeche (UAC) in Campeche, Mexico. Part of the methodology was previously reported in detail.[10–12] Briefly, a cross-sectional study collected data on different oral-health indicators in 524 individuals (14–24 years of age) selected through a nonprobabilistic sample of students enrolled at UAC.

The inclusion criteria for this analysis were (1) apparently healthy individuals who filled out a brief medical screening instrument, (2) being 14–24 years of age, (3) being enrolled in any of the selected UAC schools, (4) individuals who were accepted in the study and who signed informed consent, (5) not missing more than four teeth, (6) lacking evident TMJ disorders,[13,14] and (7) being free of clinical signs of excessive dental attrition (second and third degrees of severity of dental attrition).[15] Once the inclusion criteria were applied to the original population examined, the final sample for the present study included 254 individuals.

Variables and variable assessment

The oral clinical assessment was performed by four examiners previously trained and standardized (kappa > 0.85) for force applied in the examination, using a Dontrix device (model Richmont, Santa Cruz, California, USA). The dependent variable was the MMO, which was operationally defined as the distance from the mesioincisal edge of the upper right central incisor to the mesioincisal edge of the lower right central incisor. We considered two measures: one without assistance and one with assistance: (1) patients were asked to reach their MMO possible, and (2) patients were asked to reach their MMO possible while being assisted by putting the two index fingers of the examiner on the opposing incisal surfaces and exerting light pressure. Once the examination was concluded, the patient was informed about his or her oral status. The measured MO capacities were not adjusted by adding the vertical overlap (overbite). Independent variables were the age and sex of the participants.

Statistical analyses

A univariate analysis was performed to obtain measures of the central tendency and dispersion, as well as frequencies and percentages, depending on the measurement scales of the variables. Bivariate Student's *t*-test and Spearman's correlation tests were performed. A linear regression analysis was performed to account for the effects of age and sex. Data were analyzed using STATA 9.0 (Stata Corporation, College Station, TX USA).

Results

The study included 254 individuals, with a mean age of 16.76 ± 2.39 years, and 53.0% of participants were male. Table 1 shows the sex distribution of the two measures of MMO, reporting the maximum, minimum, and 5%, 50%, and 95% percentiles. The mean MMO and assisted MMO (AMMO) were 46.61 ± 7.37 and 49.48 ± 6.59 mm, respectively.

We observed significant differences ($P < 0.05$) across the sexes, with males having higher MMO measures. No significant differences in MO measures were identified according to Angle's occlusion classification (results not presented in table). We were unable to identify statistically significant differences ($P > 0.05$) across values derived from apparently healthy participants or from participants who stated they had any kind of symptoms pertaining to the TMJ ($n = 209$, MMO $= 47.82 \pm 7.81$ mm, AMMO $= 50.55 \pm 6.87$ mm), myofascial pain ($n = 53$, MMO $= 48.58 \pm 7.27$, AMMO $= 50.75 \pm 6.79$), disc disorders ($n = 126$, MMO $= 47.50 \pm 8.21$, AMMO $= 50.58 \pm 7.02$), or any combination of those three symptoms ($n = 30$, MMO $= 47.87 \pm 7.15$, AMMO $= 50.07 \pm 6.56$). These results are not presented.

In the multivariate linear regression model (Table 2), no relationship between the MMO and age was found ($P > 0.05$), but differences in the mean MMO and AMMO between males and females were 3.29 ($P < 0.001$) and 3.16 mm ($P < 0.001$), respectively.

Discussion

The present study determined two measures of MO in apparently healthy Mexican adolescents and young adults, observing respective mean values of 46.61 ± 7.37 and 49.48 ± 6.59 mm for MMO and AMMO.

We compared our results with other studies in the literature only with regard to the first parameter, as AMMO

Table 1 Distribution of MMO and AMMO (mm) across sexes.

	MMO	AMMO
Male (*n = 133*)		
Mean ± SD	48.17 ± 7.86	51.00 ± 7.15
Minimum	28	32
Maximum	69	75
Percentile 5	33.7	40
Percentile 50	49	51
Percentile 95	61	62.3
Female (*n = 121*)		
Mean ± SD	44.90 ± 6.40	47.83 ± 5.49
Minimum	29	32
Maximum	58	60
Percentile 5	32.1	38.1
Percentile 50	45	49
Percentile 95	54.9	57
P value[a]	0.0004	0.0001
Male and female *(n = 254)*		
Mean ± SD	46.61 ± 7.37	49.48 ± 6.59
Minimum	28	32
Maximum	69	75
Percentile 5	33	39
Percentile 50	47	50
Percentile 95	59	61

AMMO = assisted maximum mouth opening; MMO = maximum mouth opening; SD = standard deviation.
[a] Student's t-test contrasting differences across sexes.

has not been discussed in the literature to our knowledge. Other studies carried out in different countries and targeting other racial/ethnic groups suggest that wide variability exists both across and within population groups. One report found lower readings than ours. Gallagher and colleagues[4] determined a mean MMO of 42.2 mm in an Irish population of 16—99 years of age. Of note is the fact that those authors used an approximation of the measurement, not actual millimeters. Some researchers published figures that resemble ours, such as Cox and Walker[3] in Nepal (18—68 years of age), who reported a mean MMO of 47.1 mm. A third group of studies reported higher mean MMO readings, such as Yao and colleagues[6] in Taiwan (20—80 years of age) who reported 49.10 ± 6.30 mm, which is almost 3 mm higher than our findings. If we circumscribe the comparison to the age group of 20—39 years, the difference was even larger (almost 5 mm). Landtwing[16] reported results from 11—19-year-old Swiss adolescents with a mean of 49 mm. In the United States, Zawawi and colleagues[1] found a mean MMO of 48.8 mm (21—41 years of age).

Table 2 Linear regression analysis on MMO and AMMO (mm) adjusted for age and sex.

	MMO	AMMO
Age	0.33	−0.02
	(−0.04—0.70)	(−0.35—0.31)
P value	0.079	0.913
Sex		
Female (*n = 121*)	1[a]	1[a]
Male (*n = 133*)	3.29 (1.51—5.06)	3.16 (1.57—4.76)
P value	< 0.001	< 0.001

[a] AMMO = assisted maximum mouth opening; MMO = maximum mouth opening.

Differences across studies are mainly due to two reasons: (1) methodologic discrepancies in the strategies to determine MMO (including which age groups are studied), and (2) the racial background, which manifests as differences in the physical (size) and anthropometric (anatomical) makeup of the facial structure. In terms of methodologic disparities, the interpretation of comparisons ought to take into account that age ranges vary quite markedly across studies. Because morphologic changes related to attrition, bruxism, and trauma become more evident as a person ages, it is not surprising that the inclusion of different target age groups may change MMO and AMMO readings. Although it is not readily apparent in the relatively narrow age range we used (purposive as it was, to minimize the MMO/AMMO impacts derived from the above-described factors), other authors indicated that MMO decreased with age among Irish and Taiwanese people.[4,6]

Other methodologic aspects are worth considering, e.g., the actual measurement approach. For example, Zawawi and colleauges[1] proposed determining the MMO using the width of three fingers (index, middle, and ring finger) or four fingers (except thumbs) lined up vertically between the upper and lower central incisors. Mezitis and colleagues,[17] Cox and Walker,[3] and Yao and others[6] proposed measuring the interincisal distance using a ruler. Wood and Branco[18] compared direct (intraoral) and indirect (extraoral) methods, and they concluded that direct methods were preferable; this is the reason we used such an approach. One methodologic shortcoming is that the MMO capacity seemed to be measured only once. Multiple measuring is especially important for assessing the AMMO capacity because the force applied can vary even when examiners are standardized.

A consistent finding across studies is the significant difference between males and females. This is likely due to the physical size; males are generally larger than females, so the head and face bone structures are accordingly bigger. Our study was performed on Mexican adolescents and young adults and confirmed the existence of differences in anatomic characteristics between males and females. We also created a more-precise characterization of MMO variables, therefore allowing those anthropometric data to be directly relevant to the racial profile that makes up a young Mexican population group. Besides finding that Mexican young males have a higher mean MMO than females, the present study offers the first anthropometric data relevant to orthodontic and prosthetic/prosthodontic developmental calculations for an important parameter of normal mandible/maxilla function among Hispanics/Mexicans.

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